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CEL-1 User's Guide Update

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ABSTRACT

This is a guide to using the CE1-1.1 version of the CEL-1 Lighting Computer
Program. CEL-1.1 has the capability of producing hour-by-hour lighting power
multipliers for a one-year simulation period. This guide focuses on:

a) the new program routines

b) the interactive capabilities of CEL-1.1

c) the procedures for compiling different types of routines

d) computer terminology and accessing the necessary routines for running
    CEL-1.1

e) updates and revisions to the existing CEL-1 manuals

Key words: BLAST generator, cloud ratio, direct and diffuse
            illuminance, direct and diffuse irradiance, lighting
            power multipliers

FORWORD

This report documents the results of National Bureau of Standards (NBS) research in support of the Naval Civil Engineering Laboratory. The report summarizes work conducted during the period January 1983 through October 1983.

DISCLAIMER

Certain commercial equipment, instruments, or materials are identified in this report to specify the experimental procedure. Such identification does not imply that the materials or equipment identified are necessarily the best available for the purpose.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

CEL-1.1 is an updated version of the CEL-1 lighting computer program. The modifications include the use of weather data in the daylighting subset of the program and the capability of a one-year simulation. The weather data consist of diffuse and direct irradiance values which are used to generate the illuminance values. These values are used to produce hour-by-hour lighting power fractions which are output in the form of BLAST lighting Schedules and LIGHTS statements.

CEL-1 Lighting Computer Program was designed to be used as an aid to engineers in the designing of energy efficient buildings. CEL-1 has three subsets which are:

1) Electric Light subset
2) Daylight subset
3) Partition/Synthesis subset

The Electric Light subset is designed to compute illuminance at a large number of target locations. The Daylight subset performs daylight calculations for more than one condition. The Partition/Synthesis subset is used when the design synthesizer is called and furniture is in the room.

With the updated version there is a fourth subset which is used whenever daylighting calculations and BLAST lighting Schedules are needed. This subset is designed for profile mode. The Daylight/BLAST subset is shown in the shaded portion of figure 1.

This paper should be used as a guide to running CEL-1.1. The user should be familiar with the terminology and the procedures of CEL-1 before using CEL-1.1. See the reference list at the end of this report for information on existing CEL-1 manuals. Section 2 describes the main program routines, including updates and changes. Sections 3 and 4 cover the use of tapes and interactive capabilities. Section 5 contains information about compiling the program routines. Appendices A through D describe how to access the Boeing Computer System and execute CEL-1.1 Appendices E through G cover technical information internal to CELI. A sample CEL-1 data deck is shown in Appendix H and the related output is listed in Appendix I. Revisions to the CEL-1 User's and Programmers Guides are contained in Appendix J.

2. MAIN ROUTINE DESCRIPTIONS

2.1 C3435B

Purpose

Program C3435B directs the calls to the subroutines which are used for the weather data input and the BLAST Lighting Schedules output.

Method

1) Checks to see if the BLAST Lighting Schedules run has been requested.

2) Calls the necessary routines for the weather data input and the BLAST Lighting Schedules run.

2.2 INIT

Purpose

Subroutine INIT initializes the variables which control the number of repetitons of CEL34B and CEL35B. INIT checks the weather data file for errors and reads the data.

Method

1) The data is read from binary disc files.

2) The variables are initialized.

3) Checks for the weather data file and gives an error message if it is not available.

4) Reads the weather file title data and gives an error message if it is incorrect.

5) Reads the weather data until the first day is found.

6) The data is passed to the other routines by the common block /DATA/.

Variables/Arrays

LUDAY - logical unit #32, latitude, longitude, occupancy factors, etc.
LUBAS - logical unit #8, common block /COBAS/
LUBS   - logical unit #95, initial values for DY1, FRSTDY, LSTDY
HBLST - keyword for the BLAST Lighting Schedule generator, HBLST = 1 then
           BLAST generator is run
WTHRFL - weather data file
WFSDAY - starting day of the weather data file
DAYYR - day of the year for one record on the weather file
WFEDAY - ending day of the weather file

Note: All the other variables in the common blocks, which are not defined in this manual, are not used by CEL-1.1. They are there for the convenience of the programmer.

2.3 WEATHER

Purpose

Subroutine WEATHER reads diffuse irradiance and direct irradiance. It converts the data into diffuse horizontal illuminance, direct horizontal illuminance, and cloud ratio. This data is stored on disc LUWEA, one record per day.

Method

1) Direct and diffuse irradiance are read from WTHRFL.

2) Diffuse horizontal illuminance is calculated according to the following equation:

$$E_d = 119 \times I_d$$

where E_d = diffuse horizontal illuminance (lux)
        I_d = diffuse horizontal irradiance (Wm^{-2})
        119 = luminous efficacy for diffuse illumination (lumens/watt) [1].

3) Direct horizontal illuminance is calculated using the following relation:

$$E_D = E_T - E_d$$

where E_D = direct horizontal illuminance (lux)
        E_T = total horizontal illuminance (lux) [1].

Total illuminance is calculated using the following equation:

$$E_T = (105 \times I_T) + (14 \times I_d)$$

where I_T = total irradiance (Wm^{-2})
        105 = the luminous efficacy for direct irradiance (lumens/watt) [1].

Total irradiance is calculated using the following equation:

$$I_T = I_d + (I_{DN} \times \sin h)$$

where I_{DN} = direct normal irradiance (Wm^{-2})
        h = solar elevation.

4) Cloud ratio is calculated according to the following equation:

$$CR = \frac{I_d}{I_T}$$

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where   CR = cloud ratio [1].

5) Direct and diffuse illuminance and cloud ratio are written to disc. There is one record for each day which contains 24 hours of data. This comprises the array WEA.

Variables/Arrays

LUWEA - logical unit 96, contains the processed weather data (illuminances and cloud ratio)
WTHRFL - logical unit 97, unprocessed irradiance data from BLAST weather tape
DY   - julian day
HR   - hour
IDIF   - diffuse irradiance
IDIR   - direct irradiance
ITOT   - total irradiance
ETOT   - total illuminance
TIM   - converts HR to a real number
ELEV   - solar elevation
AZ   - solar azimuth
WEA   - 3X24 array containing cloud ratio, diffuse and direct illuminance for 24 hours a day
ENVDAT - common block containing weather data from BLAST weather tapes

2.4 LOOP

Purpose

Subroutine LOOP calls CEL34B and CEL35B repeatedly depending on the number of days requested. Calculations are done in groups of three days. Each time through the loop, new illuminance data and cloud ratio data are supplied. The illuminance values are no longer supplied by HFCSUN and HFCSKY. Instead, parts of the code from these subroutines have been included in the code of DAYEFB, ZENLUMB, and CEL34B.

Method

1) The processed weather data is read from LUWEA.

2) Checks for non-working days and keeps checking the days until there is a working day.

3) Selects five hours during the working day symetric about solar noon, and then interpolates the weather data for those hours.

4) The weather data is stored in EDIF, EDIR, and CR accordingly. Each of these is a linear array of 15 elements with hours 1 thru 5 in the first day calculated, hours 6 thru 10 in the second day calculated, and hours 11 thru 15 in the third day. This data is in the common block/WEATH/.

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5) Checks for the last day requested in the run and repeats the last day, if necessary, to fill the data arrays so they contain three days of data.

6) Calls CEL34B and CEL35B.

7) Checks to make sure all the requested days have been processed.

Variables/Arrays

DY   - Julian day
NDY   - counter for creating the block of three days
DYINDX - the index for the starting element of the first hour of each day in the data arrays (index values = 1, 6, 11)
HRI   - hour

2.5 CEL34B

Purpose

This subroutine is a modified version of CELO34 from the original CEL-1. CEL34B generates the daylight effects for all the times for which daylight calculations are needed.

Method

1) Read in the already computed values from disc.

2) Convert local time to solar time and compute solar position.

3) Cloud ratio is used to choose the sky condition. If CR is less than or equal to 0.2, then it is clear. If the CR is greater than 0.2 and less than or equal to 0.8, then it is partly cloudy. If CR is greater than 0.8, then it is overcast.

4) If it is overcast, calculate the effect of unit luminance for an overcast sky. Factor the unit luminance values and write them to disc. Refer to sections 3.7 and 3.8 for a further explanation of these calculations.

5) It it is clear or partly cloudy, calculate the daylight effect and then add the solar component. In the original CELO34, HFCSUN calculated the solar component. CEL34B directly uses values for direct illuminance instead of calling HFCSUN. Since the illuminance values are in lux on the weather file, the conversion to footcandles is done here. Write the values to disc. Refer to sections 3.7 and 3.8 for further explanation of the daylight calculations.

Variables/Arrays

EDIR   - direct illuminance
CR   - cloud ratio
TT   - solar time
SUNAZ   - solar azimuth

SUNEL   - solar elevation
ZLUM   - zenith luminance
HSUN   - horizontal illuminance due to the sun

2.6 CEL35B

Purpose

This subroutine is a modified version of CELO35 from the original CEL-1. CEL35B
generates the energy profile (lighting power multipliers) for daylight-affected
lighting systems. It has been modified to select the sky condition according
to the cloud ratio and it runs only once for each sky condition.

Method

1) Read in previously computed values from disc.

2) Establish the ID of each luminaire's photometry.

3) Determine the first and last hour of building occupancy.

4) Adjust array LGRP if luminaires are controlled individually. This will
   make the number of dimming groups equal to the number of luminaires.

5) The luminaires to be dimmed are grouped together.

6) To minimize the disc accesses required during the profile calculations,
   CMPRES is call ed [2].

7) The total possible watts consumed is computed and the quadratic coefficients
   are adjusted if dimming is not continuous.

8) The energy consumed by the luminaires with no daylight present is calculated.
   The result is the energy consumption before sunrise and after sunset.

9) For each time, gain settings are calculated by MSTRSN [2].

10) Cloud ratio is used to choose the sky condition in the same manner as in
    CEL34B.

11) Check for the last day. If it is the last day, read the contribution from
    disc and call MSTRSN to calculate the gain settings for each time instance.

12) If it is not the last day, set the gains to zero at the start of the next
    new day. Continue the same as above in Step 11.

13) Compute the hourly profile for each day for which calculations were made.

14) Use the osculating polynomial coefficients to get the hourly energy for a
    particular day (OCSU) [2].

15) Write the energy profile consumption (lighting power multipliers) for each day and hour to disc (LULPM).

Variables/Arrays

LULUM - logical unit #13, luminaire locations and orientations
LUKTL - logical unit #29, defines the array of target point coordinates, viewing directions, etc.
LUSURF - logical unit #31, exterior building and ground surface definitions
LUDIM - logical unit #19, parameters for luminaire control/energy profile
LUSEN - logical unit #20, sensor definitions: locations, orientations
LUDAY - logical unit #32, latitude, longitude, occupancy factors, etc.
LUBAS - logical unit #8, common block/COBAS/
NLUM   - # of luminaires
NFOTO - the # of different photometric files used
OCCUP - the occupancy factor for a particular hour
NCONTR - the # of controlled luminaires
INDW   - an array which associates the luminaires with quadratic coefficients giving watts vs. gains
LUCONT - logical unit #25, the contribution from each luminaire to the target points, the area points, and the sensors
NINSEN - the # of interior sensors
NCTAPS - the # of area points
NTAR   - the # of target points
INRECD - indicator of which disc record is currently in memory
TOTALW - the total watts from the controlled luminaires
ALWAYS - the watts from the luminaires always being on
LUDEF - logical unit #45, daylight effects for each time instant
LGRP   - the array which identifies the dimming group each luminaire belongs to; all luminaires with the same gain must be in one dimming group
WUSE   - the watts consumption for each day and hour (array)
EN   - an array containing 3 days and the hourly energy consumption
EE   - the energy consumption for the controlled luminaires
OUT   - the energy profile consumption for each day and hour (lighting power multipliers)

2.7 DAYEFB

Purpose

Subroutine DAYEFB is a modified version of the original DAYEF from CEL-1. It computes the total daylight effect on all target points, area points, and sensors depending on the sky condition which is chosen in CEL34B.

Method

1) Call TRIGS to compute the trigonometric functions of solar azimuth and solar elevation [2].

2) Call ZENLUMB to calculate zenith luminance.

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3) If it is overcast, then the zenith luminance value is 1000.

4) Compute the horizontal solar illuminance on the earth due to the direct sunlight. If it is overcast, set the value to zero. Calculate the horizontal illuminance on the earth due to the unobstructed sky. If it is overcast, then set the value for the illuminance to 777.778. The illuminance values are converted from lux to footcandles since the weather data is in metric units and CEL-1.1 uses english units.

5) From this point on, the calculations are the same as the original DAYEF [2].

Variables/Arrays

```
ISKY    - sky condition:  1 = overcast, 2 = clear, 3 = partly cloudy
TIME    - solar time
LUPRO   - logical unit #41, prototype FCTs
LU48    - logical unit #48, destination of 48-ray projections from the target
              points
LUFCTS  - logical unit #16, FCTs on interior surface, sensors, area points
LUZONE  - logical unit #15, zonal multipliers for 48-ray projections
LUFTM   - logical unit #22, flux transfer matrix
LUSLUM  - logical unit #42, relative initial illuminance on the room surfaces
              due to fenestration
```

2.8 ZENLUMB

Purpose

Subroutine ZENLUMB generates the zenith luminance depending on the cloud ratio. It is a modified version of the original ZENLUM.

Method

1) Compute the horizontal illuminance on the earth due to the unobstructed sky. Refer to section 2.7 - step 4 for a further explanation.

2) If the sky condition is overcast, then the zenith luminance is calculated
    by:

$$ZL = 9/7 \times FC$$

    where ZL = zenith luminance
           FC = horizontal sky illuminance [2].

3) If the sky condition is clear or partly cloudy, then the zenith luminance
    is calculated by:

$$ZL = FC/Z$$

    where ZL = zenith luminance
           FC = horizontal sky illuminance
            Z = obtained from the implied fixed relationship between the
                horizontal sky illuminance and the zenith luminance [2].

Variables/Arrays

ISKY   - 1 = overcast, 2 = clear, 3 = partly cloudy
NX   - counter for the number of times (1 to 15)
ICOND   - atmospheric condition indicator not used at this time

2.9 MONDAY

Purpose

Subroutine MONDAY converts the julian date into a three letter abbreviation for
the name of the month. It generates the number of the month and the number of
the day of the month.

Method

1) Compares the julian date with the julian date of the last day of the month.
    This process will choose the correct three letter abbreviation.

2) Determines the number of the day of the month.

Variables/Array

MN   - the number of the month (1 to 12)
JDAY   - julian date (1 to 366)
MON   - contains the ending julian date for each month
MONNM   - contains the three letter abbreviations for the names of the months
DAYMON - the number of the day of the month (1 to 31)
MONTH   - single element of the array MONNM

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2.10 BLSTOUT

Purpose

BLSTOUT creates a BLAST Lighting Schedule and LIGHTS statement to reference the lighting schedule. Each schedule contains a whole week of lighting power multipliers. The schedules are from Sunday to Saturday. The subroutine fills the schedules for weekends and days outside of the requested range with zero lighting power multipliers. This is to make a full week of schedules.

Method

1) Read the lighting power multipliers from disc LULPM.

2) Calculate the julian date for the Sunday of the first week.

3) Calculate the number of weeks of schedules to output.

4) Write the title information.

5) Check for non-working day. If it is a non-working day, then write the lighting power multipliers for the day as all zeros.

6) Otherwise, if it is a working day, write the BLAST Lighting Schedule for the day.

7) Write the LIGHTS statements for each week.

Variables/Arrays

NW   - the number of the week for the BLAST schedule, it ranges from 1 to the number of weeks requested.
ND   - the number of the day of the week (1 to 7)
DY   - the julian date
LSTWK   - last week requested
DAYNAM - an array of literal names of the days of the week
MON   - a literal name of a month
M   - number of the month (1 to 12)
D   - the number of the day of the month (1 to 31)
KTWATT - total watts in kilowatts

2.11 CEL01

Purpose

CEL01 reads the data deck and stores the data on binary disc files which can be used throughout the program.

Method

CEL01 has been modified to read the additional data, from the data deck, for the BLAST Lighting Schedule generator. This data includes:

- the julian date of the first Saturday of the year,
- the julian dates of the first and last days of the generator run,
- the "BLS" key for the Calculate block [3].

This data is stored on a disc file, LUBS (logical unit #95).

2.12 EQTIME

Purpose

EQTIME calculates the equation of time. This equation for time accounts for variations between solar time and clocked time due to two factors:

(1) the elliptical orbit of the earth and
(2) the solar declination of the axis.

Method

The equation of time is calculated using the following relation:

$$ET = 170 \times \sin \left[\frac{4\pi}{373} (J-80) \right] - 1.29 \times \sin \left[\frac{2\pi}{355} (J-8) \right]$$

where   ET = equation of time (decimal hours)
          J = julian data (1 ≤ J ≤ 365) [7].

2.13 ZENLUM

Purpose

ZENLUM computes the zenith luminance for given sky conditions. It has been modified to include values of Z for solar altitudes from 0° to 90° in steps of 5°.

Method

The same as the original ZENLUM [2].

2.14 FFPAR

Purpose

The purpose of FFPAR is the same as the original. Refer to the CEL-1 Programmer's Guide for a further explanation [2].

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Method

1) The form factor between two parallel surfaces is given by:

$$F_{12} = \frac{Z^2}{2\pi A_1} \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{2} \sum_{m=1}^{2} H(U_i, V_j, X_k, Y_m) (-1)^{i+j+K+m}$$

where

$$H(U_i, V_j, X_K, Y_m) = b \sqrt{(1+a^2)} \tan^{-1} \frac{b}{\sqrt{1+a^2}} + a \sqrt{(1+b^2)} \tan^{-1} \frac{a}{\sqrt{(1+b^2)}}$$

$$- 1/2 \ln (1+a^2+b^2)$$

$$a = \frac{1}{2} (X_K - U_i)$$

$$b = \frac{1}{2} (Y_m - V_j)$$

$$A1 = \text{area of surface } 1 = (Y_2-Y_1)(X_2-X_1).$$

Variables/Arrays

X1,X2 - X-span of the source surface
Y1,Y2 - Y-span of the source surface
X3,X4 - X-span of the receiving surface
Y3,Y4 - Y-span of the receiving surface
Z   - distance between the two surfaces

2.15 FFPER

Purpose

The same as the original FFPER. Refer to the CEL-1 Programmer's Guide [2].

Method

1) The form factor between two perpendicular surfaces is given by:

$$F_{12} = \frac{1}{2\pi A_1} \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{2} \sum_{m=1}^{2} G(V_i, Z_j, X_k, Y_m)(-1)^{i+j+k+m}$$

where

$$G(V_i, Z_j, X_k, Y_m) = a \sqrt{(b^2+c^2)} \tan^{-1} \frac{a}{\sqrt{(b^2+c^2)}} + \frac{1}{4} (a^2-b^2-c^2)x \ln (a^2+b^2+c^2)$$

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$$a = Y_m - V_i$$
$$b = Z - Z_j$$
$$c = X_k - X$$
$$A_1 = \text{area of surface 1} = (X_2 - X_1)(Y_2 - Y_1)$$
$$X = \text{X-coordinate of surface 2.}$$
$$Z = \text{Z-coordinate of surface 1.}$$

Variables/Arrays

A1,B1 - Y-span of the source surface
C1,D1 - X-span of the source surface
C2,D2 - Z-span of the receiving surface
A2,B2 - Y-span of the receiving surface

2.16 SKYLUM

Purpose

The purpose of SKYLUM is the same as the original SKYLUM. The calculations for the three sky types are different from the original.

Method

1) The clear sky luminance distribution is given:

$$L = L_z \; \frac{(.91 + 10 \exp(-3\,\nu) + .45 \cos^2 \nu)(1 - \exp(-.32/\cos \zeta))}{(.91 + 10 \exp(-3\,Z_0) + .45 \cos^2 Z_0)(1 - \exp(-.32))}$$

where L = sky luminance at point P
L_z = sky zenith luminance
ν = angle between the sun and sky point P
ζ = zenith point angle
Z_0 = zenithal sun angle [7].

2) The partly cloudy sky luminance distribution is calculated by:

$$L = L_z \; \frac{(.526 + 5 \exp(-1.5\,\nu))(1 - \exp(-.80/\cos \zeta))}{(.526 + 5 \exp(-1.5\,Z_0))(1 - \exp(-.80))}$$

where L = sky luminance at point P
L_z = sky zenith luminance
ν = angle between the sun and sky point P
ζ = zenithal point angle
Z_0 = zenithal sun angle [7].

3) The overcast sky luminance model is given by:

$$L = \frac{L_z}{3} (1 + 2 \cos \zeta)$$

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where   L = sky luminance at point P
        L_z = sky zenith luminance
        ζ = zenithal point angle [7].

Variables/Arrays

ZL   - zenith luminance
AZ   - solar azimuth in degrees
EL   - solar elevation in degrees
ZS   - solar declination from zenith (90-EL)
ZP   - zenithal point angle (90-PEL)
PAZ   - azimuth of the sky point in degrees
PEL   - elevation of the sky point in degrees
PSI   - angle between the sun and sky point
DENOM   - denominator for the clear sky calculation
DENOMP - denominator for the partly cloudy sky condition

2.17   SOLPOS

Purpose

SOLPOS computes the elevation and azimuth of the sun as a function of the day of the year and the position on earth.

Method

1) Solar elevation is calculated by:

$$a_t = \arcsin (\sin \ell \sin \delta - \cos \ell \cos \delta \cos(\pi t/12))$$

where a_t = solar elevation
        ℓ = site latitude
        δ = solar declination
        t = solar time [7].

2) Solar declination is calculated by:

$$\delta = 0.4093 \sin \left(\frac{2\pi}{368}(J-81)\right)$$

where δ = solar declination in radians
        J = julian date $1 < J < 365$ [7].

3) Solar azimuth is calculated by:

        Positive - Afternoon
        Negative - Morning

$$a_s = \arctan \frac{\cos \delta \sin (\pi t/12)}{\cos \ell \sin \delta + \sin \ell \cos \delta \cos (\pi t/12)}$$

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where a_s = solar azimuth
       ℓ = site latitude
       δ = solar declination
       t = solar time [7].

Variables/Arrays

```
LAT      - latitude in degrees
L        - latitude in radians
TIM      - solar time
SUNAZ    - solar azimuth
RADTODG  - conversion from radians to degrees
DGTORAD  - conversion from degrees to radians
DAY      - julian date
DEL      - solar declination
```

2.18 VSKY

Purpose

VSKY no longer computes a multiplier. It interpolates between vertical half-sky illuminance constants depending on the altitude and azimuth.

Method

1) The illuminance constants are contained in data statements. There are 19 statements for clear sky and 19 for partly cloudy.

2) The interpolation is the hyperbolic interpolation which is explained in section 2.2 of the CEL-1 Programmer's Guide [2].

3) For overcast sky condition, the method is the same as the original [2].

Variables/Arrays

```
D11      - hyperbolic interpolation coefficient
D12      - hyperbolic interpolation coefficient
D21      - hyperbolic interpolation coefficient
D22      - hyperbolic interpolation coefficient
P1 thru P19 - arrays containing 19 elements of vertical half-sky illuminance
              constants for partly cloudy sky condition
C1 thru C19 - arrays containing 19 elements of vertical half-sky illuminance
              constants for clear sky condition
CL       - 19 × 19 array containing C1-C19
PC       - 19 × 19 array containing P1-P19
```

3. CEL-1.1 TAPES

All of the CEL-1.1 program files are stored on tape at Boeing Computer Services. There are two tapes available to the user.

Tape #1: This tape contains all the CEL-1.1 program files. These include:

- FORTRAN Source Files
- FORTRAN Binary Files
- Data Files
- Procedure Files
- Program Support Files

Tape #2: This tape contains only the files necessary for running CEL-1.1. These include:

- FORTRAN Binary Files
- Data Files
- Procedure Files

Refer to section 4 for further information about accessing these tapes.

4. INTERACTIVE CAPABILITIES

4.1 CELJOBS

CELJOBS is a procedure file which calls JOBS, an interactive program. JOBS asks questions and the user supplies the necessary information. The user is asked questions about what type of program to run, which program to run, account information, job priority, and submitting the job.

JOBS allows the user to access 4 batch programs and 2 interactive programs. (Only one program can be chosen with each run of CELJOBS.) The four batch programs are:

- GATHRUN will submit the job to access tape #2 (run files only).

- GATHALL will submit the job to access tape #1 (all files).

- RUNOUT will remove the files on tape #2 from the user's account. This should be done after the user has finished running CEL-1.1 due to the fact that it is rather expensive to keep the files on the account for long periods of time.

- ALLOUT will remove all the files on Tape #1 from the user's account. The suggestion for RUNOUT should be followed for ALLOUT, also.

The 2 interactive programs are CEL1II and CEL1FE. Both of these programs are explained in the original CEL-1 User's Manual [3].

Refer to appendix C for information on accessing CELJOBS.

4.2 CEL1PP

The preprocessor has been modified to generate the data deck for the BLAST Lighting Schedule run. The program requests the julian date of the first Saturday of the year, the julian date of the first and last days of the requested schedule for the run, and in the calculate block, the key "BLS" can be used to request the BLAST run.

At the end, the preprocessor will check for the necessary weather data on the user's account. If it is not available, a message will be printed.

Note: The user should not enter a blank line when running the preprocessor. This will end the preprocessor session.

4.3 CEL1II

CEL1II has been modified so that it no longer uses Tape2 = Sites. This is due to a change in ZIFACE. ZIFACE does not ask for the user's location code. Instead, the user is asked if there is a file called MAILBOX on the user's account. This file contains the mailing information of the user.

ZIFACE has been modified to ask about the type of account the user has at BCS. If it is a QUE-PASA account, the user is asked for charge information.

The other modifications to ZIFACE are in the code for constructing the job file depending on the disposition of the output. For a further explanation of the "ROUTE" command and the parameters associated with it, refer to the EKS Control Statement Manual [4].

4.4   CREATING THE CEL-1.1 DATA DECK USING CELJOBS AND CELIFE

```
C>GET,CELJOBS
C>CELJOBS

-DO YOU HAVE THE NECESSARY FILES ON YOUR ACCOUNT TO RUN THE PROGRAM OF YOUR
CHOICE?(Y/N)
I>Y

-DO YOU WANT TO RUN A BATCH JOB?(Y/N)
I>N

-DO YOU WANT TO RUN AN INTERACTIVE PROGRAM?(Y/N)
I>Y

-ENTER ID OF PROGRAM YOU WANT TO RUN:
   5 = CEL1II
   6 = CELIFE
1>6

-ENTER 5 LINES OF LABEL INFORMATION, MAX 80 CHARS PER LINE:

1>CEL -1.1:  EXAMPLE DATA DECK IN PROFILE MODE
1>WEATHER DATA INPUT
1>HOURLY BLAST LIGHTING SCHEDULES OUTPUT
1>JULIAN DATES PROCESSED:   106 THRU 110
1>*******************************************

-ENTER INPUT UNITS, OUTPUT UNITS (1=ENGLISH 2=METRIC).  ENTER 2 VALUES:

1>1 2

-ENTER ROOM DIMENSIONS, DISCRETIZATION ≠ 5 IN PARIS:
 -WIDTH (E-W)
1>5.2 5
 -LENGTH (N-5)
1>11.2 11
 -HEIGHT
1>6.9 6

-ENTER SURFACE REFLECTANCES IN THIS ORDER:
   WEST WALL, NORTH WALL, EAST WALL, SOUTH WALL, FLOOR CEILING
```

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```
1>.47 .47 .47 .47 .30 .85

-HOW MANY ROOM SURFACE INSERTS
1>0

-DO YOU WANT TO USE DAYLIGHT (Y/N)
1>Y

-HOW MANY OBSTRUCTIONS ARE PRESENT IN THE ROOM
1>0

-DO YOU WANT TO COMPUTE ESI RATINGS (Y/N)
1>N

-ARE TASK LOCATIONS ON A RECTANGULAR GRID (Y/N)
1>Y
-ENTER DETAILS FOR GRID OF TASK LOCATIONS:
 - ≠ COLUMNS (MAX 10)
1>2
 - ≠ ROWS (MAX 10)
1>2
 -LEFTMOST X-COORDINATE
1>2
 -RIGHTMOST X-COORDINATE
1>4
 -LOWEST Y-COORDINATE
1>3
 -HIGHEST Y-COORDINATE
1>6
 -HEIGHT ABOVE FLOOR
1>2.5
 -OBSERVER EYE HEIGHT
1>4

 -HOW MANY VIEWING DIRECTIONS
1>1
 -ENTER 1 VIEWING DIRECTION ANGLES
1>0

 -ENTER ≠ INTERIOR SENSORS, ≠ EXTERIOR SENSORS
1>3 0

 -FOR EACH INTERIOR SENSOR, ENTER 4 PARAMETERS:
     X-COORD, Y-COORD, Z-COORD, ORIENTATION (5 or 6)
  LOC ≠  1:
1>266 2.8.2.5 6
  LOC ≠  2:
1>2.6 5.5 2.5 6
  LOC ≠  3:
1>2.6 7.4 2.5 6
```

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```
  -HOW MANY WINDOW TYPE DEFINITIONS (Max 10)
1>1


------FOR WINDOW DEFINITION ≠  1 ------
  GLAZING (1=CLEAR, 2=DIFFUSING)
1>1
 `TRANSMITTANCE
1>.67
  WIDTH, HEIGHT OF WINDOW
1>5.2 2.8
  HOW MANY LOCATIONS (MAX 50)
1>1

 FOR EACH LOCATION, ENTER THESE 4 PARAMETERS
  SURFACE ≠, (X,Y,Z) COORDINATES OF CORNER NEAREST ORIGIN

LOC ≠  1:
1>2 0 11.2 3.1

 ARE THERE PULL-DOWN SHADES ON THESE WINDOWS (Y/N)
1>N

 ARE THERE DRAPES ON THESE WINDOWS (Y/N)
1>N

 ARE THERE BLINDS ON THESE WINDOWS (Y/N)
1>N

 DO THESE WINDOWS HAVE A LIGHT SHELF (Y/N)
1>N

 ARE THERE BARRIERS OUTSIDE THESE WINDOWS (Y/N)
1>N

-HOW MANY CLERESTORY TYPE DEFINITIONS (MAX 9)
1>0

-HOW MANY SAWTOOTH TYPE DEFINITIONS (MAX 9)
1>0

-HOW MANY SKYLIGHT TYPE DEFINITIONS (MAX 9)
1>0

-HOW MANY BUILDINGS
1>1

------FOR BUILDING ≠  1 ------
 (X,Y,Z) COORDINATES OF LOWER SOUTHWEST CORNER
1>-1 -1 -1
```

```
 E-W DIMENSION, N-5 DIMENSION, HEIGHT
1>7.2 13.2 8.9

 REFLECTANCES, IN THIS ORDER:  WEST FACE, NORTH FACE,
     EAST FACE, SOUTH FACE, ROOF
1>.6 .6 .6 .6 .2
 BUILDING ANGULAR DISPLACEMENT FROM TRUE NORTH
1>0

-WHAT IS GROUND REFLECTANCE
1>.2
-HOW MANY GROUND INSERTS
1>0

-ENTER LATITUDE OF SITE, LONGITUED OF SITE, LONGITUDE AT CENTER OF TIME ZONE,
  WEATHER STATION ID
1>38.5 77.0 75.0 53
 ENTER DAYLIGNT SAVINGS TIME MAP (12 BINARY VALUES)
1>0 0 0 0 1 1 1 1 1 1 0 0

-IS THIS AN ENERGY PROFILE RUN (Y/N)
1>Y
 ENTER 24 OCCUPANCY FACTORS (ONE FOR EACH 24-HOUR PERIOD), BEGINNING
  WITH THE PERIOD (12 MIDNIGHT - 1 A. M.):

1>1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
-ENTER THE JULIAN DATE OF THE FIRST SATURDAY OF THE YEAR OF THE BLAST
 SCHEDULE (OR 1 IF BLAST SCHEDULE WILL NOT BE REQUESTED)
1>1
- ENTER THE FIRST AND LAST DAYS DESIRED FOR THE BLAST
  LIGHTING SCHEDULE.  THE PERIOD SHOULD BE NO MORE
  THAN 183 DAYS TOTAL.  THE DAY SHOULD BE IN THE FORM
  OF A THREE DIGIT NUMBER, JULIAN DATE.
 IF BLAST SCHEDULE WILL NOT BE REQUESTED ENTER 1 FOR BOTH
1>106 110

-WHICH METRICS DO YOU WANT TO PRINT OUT:
 DO YOU WISH TO RUN THE BLAST LIGHTING SCHEDULE
 GENERATION PROGRAM (Y/N)
***THIS OPTION WILL PREVENT ANY OTHER OPTIONS
***FROM EXECUTING

1>Y

-WHAT IS NAME OF FILE WITH BKGD LUMINANCE BROF FACTORS
1>P25B
-WHAT IS NAME OF FILE WITH TASK LUMINANCE BRDF FACTORS
1>P25T

-HOW MANY DIFFERENT TYPES OF LUMINARIES DO YOU INTEND TO USE
1>1
```

```
-FOR LUMINAIRE TYPE ≠  1:
-WHAT IS PHOTOMETRIC FILE NAME
1>HB43
-TOTAL INITIAL LAMP LUMENS PER LUMINAIRE
1>1250
-LIGHT LOSS FACTOR
1>1
-WIDTH OF LUMINOUS OPENING
1>2
-LENGTH OF LUMINOUS OPENING
1>4
-HEIGHT OF LUMINAIRE
1>0
-HOW MANY WATTS CONSUMED BY EACH LUMINAIRE
1>150
-WHAT IS MINIMUM GAIN (=FRACTION OF LIGHT OUTPUT) TO WHICH
 LUMINAIRE CAN BE DIMMED OR SWITCHED (0 = OFF, 1.0 = 100 LIGHT OUTPUT)

1>0
-ENTER 3 QUADRATIC COEFFICIENTS A,B,C SUCH THAT
 WATTS = A X GAIN X GAIN + B X GAIN + C

1>0 150 0
-HOW MANY LUMINAIRES THIS TYPE
1>2

-FOR EACH LUMINAIRE ENTER X,Y,Z COORDINATES AFTER '(X,Y,Z)'
 PROMPT  ENTER BEARING, TILT, CANT AFTER 'ORIENT' PROMPT.

-LUM ≠    1:
 (X,Y,Z)
1>2.6 2.8 6.9
 ORIENT
1>0 0 0

-LUM ≠    2:
 (X,Y,Z)
1>2.6 9.0 6.9
 ORIENT
1>0 0 0

-FOR DIMMING/CONTROL OF LUMINAIRES, ENTER CONTROL MEHTHOD:
  1 = ON-OFF   (GROUP CONTROL)
 -1 = ON-OFF   (INDIVIDUAL CONTROL)
  2 = HIGH-LOW-OFF  (GROUP CONTROL)
 -2 = HIGH-LOW-OFF   (INDIVIDUAL CONTROL)
  3 = CONTINUOUS DIMMING   (GROUP CONTROL)
 -3 = CONTINUOUS DIMMING  (INDIVIDUAL CONTROL)
1>-3
-ENTER 1 CONTROL CRITERION VALUE(S)
1>50
```

```
-SELECT THE CONTROLLING ILLUMINANCE VALUE FROM THESE:
  1 - MINIMUM ILLUMINANCE OVER TARGET POINTS
  2 - AVERAGE ILLUMINANCE OVER TARGET POINTS
  3 - MINIMUM ILLUMINANCE OVER CONTROL TARGET AREA
  4 - AVERAGE ILLIMINANCE OVER CONTROL TARGET AREA
  5 - MINIMUM ESI OVER THE TARGET POINTS
1>1

- HOW MANY LUMINAIRES ALWAYS OFF:
1>0

-HOW MANY LUMINAIRES TO BE DIMMED/CONTROLLED
1>2
 ENTER SEQUENCE ≠ 5 of 2 LUMINAIRES TO BE DIMMED/CONTROLLED

1>1 2
*** YOUR DATA DECK IS SAVED AS FILE 'CELIDD' - THE FILE DOES NOT HAVE
    LINE NUMBERS.  YOU MAY LIST THE FILE AND/OR CHANGE IT USING THE NOS
    EDITOR.  TO SUBMIT THE DECK FOR EXECUTION, KEY IN:

            GET,CEL1II
            -CEL1II
```

4.5   CREATING A BATCH JOB USING CELJOBS

```
  C>-CELJOBS

  -DO YOU HAVE THE NECESSARY FILES ON YOUR ACCOUNT
   TO RUN THE PROGRAM OF YOUR CHOICE?(Y/N)

  -DO YOU WANT TO RUN A BATCH JOB?(Y/N)
1>Y

  -ENTER ID OF PROGRAM YOU WANT TO RUN:
   1 = GATHRUN
   2 = GATHALL
   3 = RUNOUT
   4 = ALLOUT
1>2

  -ENTER THE PRIORITY YOU WANT TO RUN AT: (12 FORMAT) (1,2,4,6,10,11,13)
   (PRIORITY IS LISTED LOWEST TO HIGHEST)
1>01

  -DO YOU WANT TO SUBMIT THIS JOB?(Y/N)
1>Y

  -IS YOUR ACCOUNT A QUC-PASA ACCOUNT?(Y/N)
1>Y
```

```
   -ENTER YOUR CWA ACCOUNT NAME--(6 LETTER NAME)
1>MYCWAN

   -ENTER YOUR PROJECT NUMBER--(4 DIGIT NUMBER)
1>1111
 08 57 48  83/11/29.T10IBDT
```
C>GETFILE, T10IBDT
 T10IBDT IS NOW LOCAL FILE T10IBDT
C>CME,T10IBOT
E>P *

TAPE1,P01
USER,*
CHARGE,MYCWAN,111
GET,GATHALL/UN=NB5007
GATHALL
EDI

4.6 SUBMITTING THE CEL-1.1 DATA DECK USING CELJOBS AND CEL1II

```
  C>-CELJOBS

  -DO YOU HAVE THE NECESSARY FILES ON YOUR ACCOUNT
   TO RUN THE PROGRAM OF YOUR CHOICE?(Y/N)
1>Y

  -DO YOU WANT TO RUN A BATCH JOB?(Y/N)
1>N

  -DO YOU WANT TO RUN AN INTERACTIVE PROGRAM?(Y/N)
1>Y

  -ENTER ID OF PROGRAM YOU WANT TO RUN:
   5 = CEL1II
   6 = CELIFE
1>5
        -- CEL-1 INTERACTIVE INTERFACE --

  - ENTER ID OF PROGRAM YOU WANT TO RUN
     1 = CEL-1
     2 = OBMP
     3 = CCMP
1>1

  -ENTER PRIORITY FOR JOB (1,2,4,6,10,11,13) (12 FORMAT)
1>01

  -ENTER CODE FOR DISPOSITION OF OUTPUT:
   1  ROUTE TO YOUR REMOTE BATCH TERMINAL
   2  PRINT AT CENTRAL SITE, MAIL TO YOU
   3  SAVE FOR SUBSEQUENT RETRIEVAL AT INTERACTIVE TERMINAL
```

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```
1>3

  -DO YOU WANT TO SUBMIT THIS JOB?(Y/N)
1>Y

  -IS YOUR ACCOUNT A QUE-PASA ACCOUNT?(Y/N)
1>Y

  -ENTER YOUR CWA ACCOUNT NAME--(6 LETTER NAME)
1>MYCWAN

  -ENTER YOUR PROJECT NUMBER--(4 DIGIT NUMBER)
1>1111
  08 52 32  83/12/12.T10IEPT
EXIT
```

5. COMPILING THE ROUTINES

5.1 FT PROCEDURE

FT is used to compile the main program source files. To use the procedure type in:

    GET,FT
    FT,Zfilename,filename

where   Zfilename = main program source file
             filename = main program name.

For a list of main program source files, refer to the CEL-1 Programmer's Guide [2].

Note: C3435B must be compiled with FT. To compile, type in:

    FT,C3435B,C3435.

5.2 LIBREPL PROCEDURE

LIBREPL is used to compile subroutine source files and replace the old compiled version in NBSOPT2 with the new compiled version.

A subroutine source file contains only subroutines and functions. Refer to the CEL-1 Programmer's Guide for a list of subroutine source files [2]. The new subroutine files are: INIT, WEATHER, LOOP, CEL34B, CEL35B, DAYEFB, ZENLUMB, MONDAY, BLSTOUT.

To use LIBREPL type in:

    GET,LIBREPL
    LIBREPL,filename

where   filename = program name. If there are errors check the listing file, L, using CMEDIT.

Note: To use LIBREPL, the filename must be the same as the program or subroutine name. The subroutine source files, listed in the CEL-1 Programmer's Guide, have no "Z" as the first letter of the file names [2].

5.3 LIBIT PROCEDURE

LIBIT creates the relocatable library, RELOC, from the file NBSOPT2. This routine must be used after using LIBREPL. If it is not, the new compiled versions will not be in RELOC.

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To use LIBIT type in:

    GET, LIBIT
    LIBIT

Note: Both NBSOPT2 and RELOC are direct access files. The "ATTACH" command
        must be used to access them.

5.4 LIBINS PROCEDURE

LIBINS inserts a new compiled file into the relocatable library. To use LIBINS
the filename must be the same as the program name.

Type in:

    GET, LIBINS
    LIBINS, filename, extfile

where   filename = program name
        extfile = file which the inserted file should be place before in RELOC

6. SUMMARY

This report contains:

a) a description of the modified capabilities of the Daylight subset of CEL-1.1

b) a description of the BLAST generator and the output of hour-by-hour lighting power multipliers

c) an explanation of the interactive capabilities of CEL-1.1

d) an explanation of the use of the BOEING COMPUTER SYSTEM

e) new updates to the existing CEL-1 manuals

7. REFERENCES

1. Treado, S. and Kusuda, T., <u>Solar Radiation and Illumination</u>, NBS Technical Note 1148, November 1981.

2. <u>CEL-1 Lighting Computer Program - Programmer's Guide</u>, CR 83.009, Naval Civil Engineering Laboratory, Port Hueneme, CA, 93043, January 1983.

3. <u>CEL-1 Lighting Computer Program - User's Guide</u>, CR 81.026, Naval Civil Engineering Laboratory, Port Hueneme, CA, 93043, September 1981.

4. <u>MAINSTREAM - EKS Control Statement Manual</u>, 10208-133, Boeing Computer Services Company, March 1981.

5. <u>MAINSTREAM - EKS Users Guide</u>, 10208-132, Boeing Computer Services Company, October 1981.

6. <u>MAINSTREAM - EKS Interactive Timesharing (KIT) Users Manual</u>, 10208-005, Boeing Computer Services Company, October 1977.

7. <u>Recommended Practice for the Calculation of Daylight Availability</u>, IES Journal, Vol. 13, No. 4, July, 1984.

```
00010 NOTIFY.CEL-1 HAS STARTED.          00340 GET,CEL07.
00050 RETURN,RELOC.                      00345 CEL07.
00060 MAP,OFF.                           00346,REWIND,TAPE99.
00070 COPY,INPUT,TAPE5.                  00347 COPY,TAPE99,OUTPUT.
00080 REWIND,TAPE5.                       00350 GOTO,00480.
00090 REWIND,TAPE6.                       00360,GET,CEL04.
00100 ATTACH,RELOC.                       00365 CEL04.
00105 LIBRARY,RELOC.                      00370 GOTO,00460.
00108 GET,TAPE72=ERRORS.                  00372,GET,OVLY20.
00110 GET,CHECK.                          00390 OVLY20.
00120 CHECK                               00400 GET,OVLY30.
00122 IF(SW3=1)GOTO,00482.                00410 OVLY30.
00130 REWIND,TAPE5.                       00420 GET,OVLY40.
00135 REWIND,TAPE6.                       00430 OVLY40.
00140 REWIND,OUTPUT.                      00440 GET,OVLY50.
00145 GET,TAPE64=RCS866.                  00450 OVLY50.
00150 GET,CEL01.                          00460,GET,OVLY60.
00155 CEL01                              00470 OVLY60.
00160 IF(SW1=1)GOTO,00372.                00480,NOTIFY. CEL-1 HAS FINISHED.
00170 GET,CEL02.                          00481,EXIT.
00180 CEL02                              00482,REWIND,TAPE6.
00190 IF(SW2=1)GOTO,00360.                00485 COPY,TAPE6,OUTPUT.
00220 GET,CEL031.                         00490 PURGE,DAYFIL/NA.
00230 CEL031                             00500 DAYFILE,DAYFIL.
00240 GET,CEL032.                         00510 REPLACE,DAYFIL.
00250 CEL032                             00511 NOTIFY.CEL-1 HAS FINISHED WITH ERROR.
00260 GET,CEL033.                         ---
00270 CEL033
00272 GET,CEL5OL.
00274 CEL5OL
00275 GET,C3435.
00276 IF(SW4=0)GOTO,00280.
00277 C3435
0027  IF(SW4=1)GOTO,00346.
00280,GET,CEL034.
00290 CEL034.
00300 GET,CEL035.
00310 CEL035.
00320 GET,SUNHIT.
00325 SUNHIT.
```

Figure 1.   The CELPROC procedure file for Daylight/BLAST subset

```
welcome to the bcs network
your access port is bcs 0b5

select desired service:  EK51

  83/11/29. 07.56.09.
EK51 760C.N0501.94AA 83/11/15.D5-0 22.40.07. 83/11/27.
▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮
TERMINAL      17, TTY
RECOVER/USER ID: CINDY
```

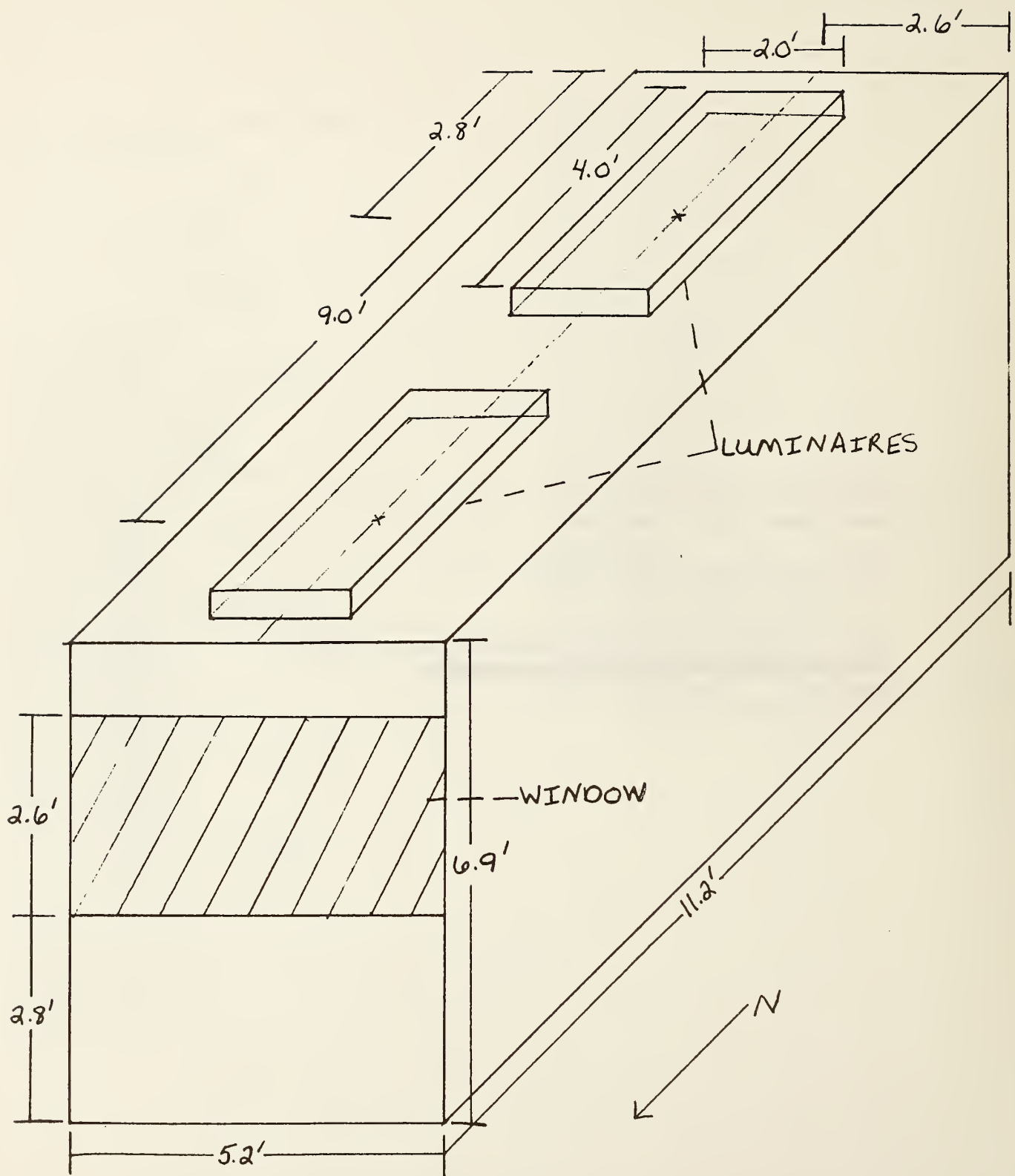Figure 2. An example of the signon procedure

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Figure 3. Room Layout for CEL-1.1 example data deck

APPENDIX A. COMPUTER TERMINOLOGY AND SYMBOLS FOR BOEING COMPUTER SYSTEM

The user should understand the following terms and symbols related to the computer before signing on:

    User number - a seven character number used to signon at the start of a
              KIT session

    QUE-PASA - an optional EKS interactive accounting system [5]

    Charge number - a ten character number assigned by BCS for QUE-PASA accounts

    CWA - Computer Work Authorization account name (6 characters)

    Project number - an internal accounting identifier for a charge number
                (4 digit number)

    CMEDIT - timesharing text editor [6]

    EKS1 - provides batch and interactive services using control data Cyber
        mainframes

    CR - carriage return

    P # - CMEDIT command which prints the requested number of lines of text

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APPENDIX B. SIGNON PROCEDURE

Before signing on, have the assigned account number, password, QUE-PASA project number, and the local Boeing Computer Services phone number. The phone number used depends on the desired line speed and the location. Set the terminal according to the MAINSTREAM-EKS KIT manual [6].

Dial up the EKS Data Center. Once connected, the following interaction takes place: (the responses entered by the user are underlined).

    welcome to the bsc network
    your access part is bsc 0bd

    select desired service: EKS1   CR

    YY/MM/DD.HH.MM.SS.
    EKS1 760A.N0501.64C YY/MM/DD.DS-0 HH.MM.SS.YY/MM/DD

    USER NUMBER: MYUSER   CR

    PASSWORD: MYPASSW   CR

    CHARGE: MYCWA, MYPROJ   CR

    TERMINAL: nnn, iii

    RECOVER/USERID: NAME   CR

where   nnn is the terminal number assigned by KIT
         iii is the identifier which describes the type of terminal [6]

C>

At this point, the signon is complete and EKS1 is ready to accept commands. Figure 2 shows an example of the signon procedure.

Note: (1) The user number, password, and charge are blacked out after entering the carriage return.

       (2) If the account is not a QUE-PASA project, then the request for a CHARGE will not appear.

       (3) If the terminal disconnects, recovery can be accomplished by typing:

            EKSP when the system prompts with "select desired service." If the system responds with "RECOVERY IMPOSSIBLE," signoff with the command BYE. Then enter EKSS.

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APPENDIX C. ACCESSING CELJOBS AND RELATED COMPUTER COMMANDS

To access CELJOBS, type:

```
GET,CELJOBS
-CELJOBS
```

This will start the interactive session. Once CELJOBS has started, the user is asked if the necessary files are available on the user's account. (Refer to appendix D for a list of files.) If the user does not have the appropriate files, CELJOBS gives a message and terminates.

When the job has been submitted, the user will get the following message:

```
HH.MM.SS. YY/MM/DD .JOBNAME.
```

The jobname consists of the "index hash" which is the first four characters of the jobname. (These four characters will always be the same.) The last 3 characters are generated randomly.

To check on the status of the job, type:

```
FIND,JOBNAME,LO=F.
```

The user is given information about the job such as: jobname, mainframe job is on, processing queue, elapsed time, when the job is executing and finished.

When the job has finished, the user should get the file. This is done by:

```
GETFILE,JOBNAME
```

The computer responds with:

```
FILE JOBNAME is now local file JOBNAME.
```

This file can then be checked for any errors that might have occurred during the job run by using CMEDIT.

If the user chooses to run CEL1II, the output will be in a direct access file. To access a direct access file, type:

```
ATTACH,filename
CME,filename
P #
```

APPENDIX D. NECESSARY FILES FOR RUNNING CELJOBS

For each of the six programs, certain files are needed in order to run the
programs. Each program is shown with a list of files that are needed on the
user's account.

Program	Files
RUNOUT	RUNOUT Files from Tape #2 (run files)
ALLOUT	ALLOUT Files from Tape #1 (all files)
CEL1II	CEL1II IFACE CHECK ERRORS RELOC (run files)
CEL1FE	CEL1FE CEL1PP RELOC

APPENDIX E. COMMON BLOCK VARIABLE DEFINITIONS

E.1 COMMON BLOCK /DATA/

This common block is the "basic" block for the modified version in that it contains all the variables used by the modified programs and the new additional programs and subroutines.

AJDAY   - a linear array of 15 julian dates (5 for each of 3 days)

AMONTH - a linear array containing the number of the month (15 elements)

ATTIME - a linear array of 15 hours

ADAY   - a linear array containing the number of the day (values - 1 to 31)

CMER   - center meridian

DSTMAP - array of 12 zeros and ones representing the months of the year with daylight savings time

DY1   - julian date of the first Saturday in the year

FRSTDY - julian date of the first day of the run

LAT   - latitude

LON   - longitude

LSTDY   - julian date of the last day of the run

E.2 COMMON BLOCK/WEATH/

This common block contains variables which describe the weather data (see section 3.3 for more details).

CR   - array of 15 cloud ratios, one for each of five hours for three days

EDIF   - arary of 15 elements containing diffuse illuminance, one for each of five hours for three days

EDIR   - arrays of 15 elements containing direct illuminance, one for each of five hours for three days

APPENDIX F. LOGICAL UNIT ASSIGNMENTS

The list below shows the logical unit numbers of the disc files used in CEL-1.1, with the description and the variable name used to refer to the file.

Number	Variable Name	Description
95	LUBS	initial values for DY1, FRSTDY, LSTDY
96	LUWEA	processed weather data (cloud ratio, illuminances)
97	WTHRFL	unprocessed BLAST weather data (irradiances)
98	LULPM	lighting power multipliers (energy profile consumption for each day and hour)

APPENDIX G.   PROGRAM CALLING SEQUENCE TREE

The diagram below defines the subroutine and function linkages of CEL-1.1.   The
notation is the same as in the CEL-1 Programmer's Guide [2].

```
C3435B
   INIT
 · WEATHER
      SOLOPS
   LOOP
      MONDAY
      SRSET
      CEL34B
          SOLPOS
          DAYEFB
          TRIGS
          ZENLUMB
      CEL35B
          QLUM
          CMPRES
          MSTRSN
              ACC1L
              CONTR1
          OSCU
              SLOPE
          CEVAL
          DIGITIZ

   BLSTOUT
          MONDAY
```

APPENDIX H.   CEL-1.1 DATA DECK

```
    ROOM
    CEL-1.1:  EXAMPLE DATA DECK IN PROFILE MODE
    WEATHER DATA INPUT
    HOURLY BLAST LIGHTING SCHEDULES OUTPUT
    JULIAN DATES PROCESSED:  106 THRU 110
****************************************************
      1 2
      5.20   5  11.20  11   6.90   6
      .470   .470   .470    .470    .300    .850
TASK
UNKNOWN
    2  2    2.00    4.00    4.00    8.00    2.50    5.80
2
      0.00    0.00
SENSORS
  3
      2.60    2.80    2.50    6
      2.60    5.50    2.50
      2.60    7.40    2.50    6
  0
FENESTRATION
WINDOW
  1    .670
      5.20    2.80
  1
2    0.00    11.20    3.10
BUILDING
  1
      -1.0       -1.0       -1.0       7.2    13.2    8.9
     .600    .600    .600    .600    .200
      0.0
GROUND
     .200
  0
PROFILE
     38.50    77.00    75.0    53    1    106    110
      0 0 0 0 1 1 1 1 1 1 1 0 0
     1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.
LUMINAIRES
HB43
     1250.0    1.000
     2.000    4.000    0.000    150.0
    0.000        0.00    150.00    0.00
      2
      1    2.60    2.80    6.90    0.0    0.0    0.0
      2    2.60    9.00    6.90    0.0    0.0    0.0
```

```
Dimming
 -3
    50.0
  1 0 0 0 0
 0 0 0 0 0 0
    0
    2
 · 1    2
CALCULATE
HOR BLS
P25B
```

APPENDIX I. BLAST SCHEDULE OUTPUT EXAMPLE

THESE FILES MUST BE INSERTED INTO AN EXISTING BLAST DECK. THE SCHEDULE
AND LIGHTS STATEMENT FILES ARE SEPARATED BY THE CHARACTERS '$$$$'.
$$$$
  DEFINE SCHEDULE(WEEK 1):
     SUNDAY   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.0,0.00,0.00,0.00,0.00,0.00),
     MONDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,   .74
           .18, .05, .59,1.00, .72, .18,1.00,1.00,1.00,1.00,1.00,1.00,1.00)
     TUESDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00 .76
           .25,0.00,0.00,0.00, .03, .08,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     WEDNESDAY = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00
          1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     THURSDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00, .58, .19, .01
          0.00,0,00,0.00,0.00, .35, .83,1.00,1,00,1.00,1.00,1.00,1.00,1.00),
     FRIDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00, .58, .19, .01
          0.00,0.00,0.00,0.00, .35, .83,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     SATURDAY   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00),
  HOLIDAY= SUNDAY
END
  DEFINE SCHEDULE(WEEK 2)
     SUNDAY   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.0,0.00,0.00,0.00,0.00,0.00),
     MONDAY   = 1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00, .79, .57, .35
           .11,0.00,0.00,0.00, .35 .83,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     TUESDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00, .68, .38, .15
          0.00, .08, .56, .99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     WENSDAY   = (1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,
          1.00, .92, .49, .11,0.00, .01,1.00,1.00,1.00,1.00,1.00,1.00,1.00),
     THURSDAY   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
     FRIDAY   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
     Saturday   = (0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00
          0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,0.00,
  HOLIDAY= SUNDAY
END
  $$$$
  LIGHTS =   .30, WEEK 1 FROM 10 APR THRU 16 APR
  LIGHTS =   .30, WEEK 2 FROM 17 APR THRU 23 APR
  $$$

APPENDIX J. REVISIONS FOR THE CEL-1 USER'S GUIDE AND PROGRAMMER'S GUIDE

The following pages contain revisions and updates to reference
3.

Discussed fully in Section V.

6300. 82
     This card gives, respectively, the total initial lamp lumens and the light
     loss factors to be used. The initial lamp lumens value is the initial
     lumen rating for one lamp multiplied by the number of lamps in the lumi-
     naire. The total lamp lumens for a particular fixture must be obtained
     from the manufacturer or the IES Handbook. The photometric files do not
     contain the actual total. The light loss factor (a real number in the
     range 0-1) is a factor which accounts for lamp lumens depreciation,
     luminaire dirt accumulation, luminaire corrosion, ballast losses, etc.

1.833 3.833 0.5 92
     This card specifies the following:

     1.833 - the width of the luminous opening of the luminaire.
     3.833 - the length of the luminous opening of the luminaire.

     Note that the length and width of the luminaire are independent of the
     luminaire's orientation in the room. To determine these values, imagine
     the luminaire positioned so that its 0 degree photometric plane is pointed
     north. Then the width of the E-W span of the luminous opening and the
     length is the N-S span of the luminous opening. For fluorescent lumi-
     naires, this 0 degree photometric plane is almost always parallel to the
     lamps. For HID luminaires (mercury vapor, metal halide, high-pressure
     sodium) with a horizontal lamp, the zero degree photometric plane is
     generally parallel to the arc tube of the lamp.

     0.5 - the height of the luminaire. Unless a fixture has both uplight and
           downlight, this value may be specified as zero.

     92 - says that the luminaire consumes 92 watts. This value only influences
           the calculations when an energy profile is being calculated, but it is
           recommended that the user cultivate the habit of always specifying it.

0 0 0 0
     This card contains 4 values which are used in energy profile calculations.
     The meaning of the values for energy profiles is discussed later in the
     section. If energy profile computations are not being performed, four
     zeros should be on the card.

     6   - This card tells the program that we are going to locate six luminaires
           within the room.

3.11 Continuous Dimming

We shall leave the room layout the same as in Example 10. The difference
is that we want to control the luminaires in such a way that a threshold ESI
value is maintained at each target point. Each luminaire can be dimmed
independently; our goal is to minimize energy consumption while maintaining at
least 30 ESI fc at each of the three task locations.

```
ROOM
EXAMPLE 11 -- ENERGY PROFILE WITH CONTINUOUS DIMMING
CRITERION IS 30 ESI FC AT EACH TASK LOCATION
ALL SIX LUMINAIRES TO BE DIMMED.

    SAME ROOM ENVIRONMENT AS FOR EXAMPLE 10.
    1 1
40   20   30   15   10   5
.5  .5  .5  .5  .2  .8
TASK
KNOWN
 3  2.5
13  8.5  0
30  8.5  0
34.5  15  -90
SENSORS
 1
20   15   10   5
 1
40   25   8   2
FENESTRATION
WINDOW
 1  0.80
8 5
 3
 4   16   0   3
 3   40   4   3
 3   40   17   3
BUILDING
 2
-100  0  -35  140  250  45
.6  .6  .6  .6  .2
-30
17  -560  -35  100  300  80
.5  .5  .5  .5  .5
-15
GROUND
.12
 1
.08  -150  250  -200  -50  -35
FURNITURE
 3
3   13   9.5   2.5   0
```

```
3  30  9.5  2.5  0
3  33.5  15  2.5  -90
PROFILE
 42.4  83.1  75.  2
0 0 0 0 1 1 1 1 1 1 1 0 0
0 0 0 0 0 0 0 0 1 1 1 1 0.5 1 1 1 1 0 0 0 0 0 0 0
LUMINAIRES
HB57
6300.   .85
1.833  3.833  0.5  92
 0.2  -50.  150.  -8
  6
1  10  10  9.5  0 0 0
2  20  10  9.5  0 0 0
3  30  10  9.5  0 0 0
4  10  20  8.5  0 0 0
5  20  20  9.5  0 0 0
6  30  20  9.5  0 0 0
DIMMING
 -3
30.
0 0 0 0 1
0 0 0 0 0 0
 0
 6
1 2 3 4 5 6
CALCULATE
ESI HOR
P25B
P25T
```

Note the following differences between this data deck and the
deck for Example 10:

1. In the LUMINAIRES block the card
        0.2 -50. 150. -8
    has non-zero values on it for the first time in the examples
    we have considered. The 0.2 value is the minimum gain
    (=fraction of light output) to which the luminaire may be
    dimmed. In this case the luminaire cannot be dimmed below
    20% light output. The remaining three numbers on the card
    consumption to gain as follows:

        watts = a x gain^2 + b x gain + c

    In this case we have a = -50, b = 150, c = -8. The watts
    computed from the above expression at full light output
    (gain = 1.0) must always equal the watts given for the lum-
    inaire -- 92 in this case.

2. In the DIMMING block we have specified luminaire control
    method - 3 -- continuous dimming with each luminaire con-

trolled individually. We have also selected 30 ESI fc minimum as our
criterion control value (this is done via the card 0 0 0 0 1). Since the
ESI criterion is applied to the target points themselves, we have no use
for a control target area and therefore have not defined one (the card 0 0
0 0 0 0 specifies 0 rows and 0 columns and therefore no control target
area is defined). Also we have specified that all six luminaires are to
be under dimming control.

For energy profile calculations, any of the five controlling criteria may be
specified, regardless of the luminaire control methol selected. The converse
is not true, however, for when the criterion is minimum ESI, only continuous
dimming may be specified.

It is important to note also that a positive luminaire control method (1, 2, or
3) results in all controlled luminaires being dimmed together, while a negative
luminaire control method (-1, -2, or -3) results in each controlled luminaire
being dimmed individually.

```
    * - required input block
    0 - optional input block
(no entry) - block is forbidden
```

The "capability set" refers to the CEL-1 capabilities being used, as follows:

```
A - no furniture, no daylight, unknown task loc'ns
B - furniture, no daylight, any tasks
C - design synthesizer
D - daylight, analysis mode
E - daylight, profile made
F - daylight, BLAST generator
```

	Capability Set					
BLOCK	A	B	C	D	E	F
ROOM	*	*	*	*	*	*
INSERTS	0	0	0	0	0	0
TASKS	*	*	*	*	*	*
SENSORS				0	0	0
FENESTRATION				*	*	*
FURNITURE		0	0	0	0	0
PROFILE					*	*
ANALYSIS				*		
LUMINAIRES	*	*		0	*	*
DIMMING				0	*	*
DESIGN			*			
CALCULATE	*	*	*	*	*	*

Data elements in the input stream will consist of three types:

a) alphabetic - these will be text ID lines, keywords, and file names. The
    latter two will have rigid column alignment requirements for their location
    on the line.

b) 'real' numeric - these may take on fractional values, if necessary. They
    may be entered with or without a decimal point. Their replacement on the
    input line is not subject to rigid column-alignment requirements, but each
    pair of numeric values must be separated by a comma and/or one or more
    spaces.

c) 'integer' numeric - these may not take on fractional values and must be
    coded in the input stream without a decimal point or numeric values must be
    separated by a comma and/or one or more spaces.

In the following discussions of the input blocks, numeric input variables are
'real' unless explicitly identified as 'integer'.

4.3 ROOM block

The ROOM block must be presented in the input stream for all four CEL-1 programs. The ROOM block is as follows:

<text ID line 1>
<text ID line 2>
<text ID line 3>
<text ID line 4>
<text ID line 5>
<units definition>
<room dimensions>
<room reflectances>

These lines take the following forms:

<text ID line x> - Each of these five lines may contain up to 80 characters of text which serves to identify the printed results. The contents of these lines are for identification purposes only in no way influence the computations.

<units definition> - this line contains the two integer values:
   <input units> <output units>

   where

   <input units> = 1 if all dimensions, distances, etc., are given in feet.
                  = 2 if all dimensions, distances, etc., are given in meters.

   <output units> = 1 if output values are to be in English units. In this case, computed luminance values will be given in footlamberts; computed illuminance values will be in footcandles.

                     2 if output values are to be in metric units. In this case, computed luminance values will be given in candelas per square meter; computed illuminance values will be in lux.

Consider the following Window sub-block examples:

Example 1:

```
WINDOW
1  .9
4. 5
   3
1  0   8  2
1  0  18  2
1  0  28  2
BARRIERS
1.  1.  -1.  1.5  .25
-1  1.   1.  1.5  .25
1.  1.  -1.  1.5  .25
0 0 0 0 0
SHELF
 0 1.0  0.75
BLINDS
 1 .02083  0.1667  0.1458  30  .80
```

This example defines 3 windows on the west wall. Each window opening is 4' across by 5' high; the windows span z-coordinates 2 - 7 and y-coordinates 8-12, 18-22, and 28-32. Barriers extend from each side and across the top of the exterior window opening. Each barrier has reflectance = 25% and protrudes 1.5 feet from the west wall. The side barriers are 1' on either side of the window opening and extend 1' below the window opening. The top barrier is 1' below the top window opening (this implies a sloping overhang which starts at the wall at or above the window opening). A light shelf protrudes 1' into the room from the bottom of the window opening; its reflectance is 75%. Venetian blinds are defined as follows:

$$\text{thickness} - 1/4 \text{ inch } (= .02083 \text{ foot})$$
$$\text{width} \quad - 2 \text{ inches } (= .1667 \text{ foot})$$
$$\text{spacing} \quad - 1.75 \text{ inches } (= .1458 \text{ foot})$$
$$\text{angle of opening } - 30 \text{ degrees}$$
$$\text{reflectance } - 80\%$$

Example 2:

```
WINDOW
 1  .9
6. 5.
 2
4  7  0  3
4  19 0  3
DRAPE
 .60  0  2.5
```

This example defines 2 windows on the south wall; each has clear glazing of 90% transmittance. Dimensions are 6' across by 5' high. Each window runs from z-coordinate 3 to

4.8 FURNITURE block

This input block is used to define the locations of obstructions in the room; it is always optional in the input deck. The format of the block is:

```
FURNITURE
< ≠ obstructions>
<ID>   <x>   <y>   <z>   <orientation>
        .                                    repeat for each
        .                                    obstruction
        .

<ID>   <x>   <y>   <z>   <orientation>
```

where

< ≠ obstructions> is an integer giving the number of obstructions defined in the block. There must be at least one obstruction or the FURNITURE block must be omitted.

<ID> is the sequential position (integer value) of the obstruction in the OBSTR database. Refer to the section "Obstructions" for details on the OBSTR database.

<x>   <y>   <z> are the (x,y,z) coordinates of the exact center of the top face of the obstruction.

<orientation> is the angular displacement (Degrees) between room north and the west face of the obstruction (as the obstruction is defined in the OBSTR database). A positive angle indicates a clockwise displacement; a negative angle indicates a counter-clockwise displacement.

Consider the following example:
```
 3
1 21.5 34.75 6 0
9 8 25  5 90
4 23 18 4  -90
```

Three obstructions are defined:

1) The first obstruction defined in OBSTR is located with its top center at (21.5,34.75,6). Its orientation in the room is the same as its OBSTR orientation.

2) The ninth obstruction defined in OBSTR has its top center located at (8,25,5). In the room, the object has been rotated 90 clockwise (relative to its OBSTR definition).

3) The fourth obstruction defined in OBSTR has its top center located at (23,18,4). In the room, the object has been rotated

4.12 DIMMING block

The DIMMING block is used only with CEL-1 daylight capability. It is optional in "analysis" mode and mandatory in "profile" mode. The format of the block is as follows:

```
<Luminaire control method>
<luminaire control criterion value (s)>
<luminaire control indicator>
<control target area definition>
<≠ luminaires always off>
<list of up to 10 luminaires always off>
     .
     .
     .

<list of up to 10 luminaires always off>
<≠ of luminaires in dimming group>
<list of up to 10 luminaires in the dimming group>
     .
     .
     .
<list of up to 10 luminaires in the dimming group>
```

These input lines are defined as follows:

<Luminaire control method> is one of the 6 integers:
                    -3, -2, -1, 1, 2, or 3
        The magnitude of the enrty defines the controlling
        strategy:

    1 - luminaires are to be controlled so that at a given time each
        luminaire is either "on" or "off".

    2 - luminaires are to be controlled so that each is in one of
        three states:
                "high" - full output
                "low"   - half output
                "off"   - zero output

    3 - luminaires are to be controlled so that each controlled luminaire
        may be continuously dimmed from full output down to some user-
        specified minimum.

    A positive control method indicates that the luminaires are to be dimmed
    together; i.e., at any given time all controlled luminaires have the
    same gain. A negative control method means that each controlled
    luminaire is to be controlled independently from all others. E.g.,
    -3 means continuous dimming, with each luminaire controlled independently;
    -2 specifies high-low-off control with all luminaires switched as a group.

<luminaire control criterion value (s)> contains 1, 2, or 4 integer values
depending on the magnitude of the <luminaire control method> selected in the
preceding line:

```
control
method      <luminaire control criterion values>
------------------------------------------------
    1       <val  1>  <val  2>
                where
            <val  1> and <val 2> are the illuminance
            values which define where lunimaires are
            switched from "on" to "off" or vice-versa.
            When the luminaire control algorithm operates.
```

4.14 CALCULATE BLOCK

This input block tells CEL-1 which lighting metrics to calculate. The block takes the following format

        CALCULATE
        <keywords>
        <background BRDF filename>
        <task BRDF filename>

where   <keywords> is a list of 3-character keywords which tell what metrics
        are to be printed on the output report. The keywords are as follows:

HOR   - print horizontal fc (no body shadow)

ESI   - print Equivalent Sphere Illuminance (ESI)

RFC   - print horizontal fc (incl. body shadow)

TAR   - print target luminance

BAC   - print background luminance

LEF   - print Lighting Effectiveness Factor (LEF)

CRF   - print Contrast Rendering Factor (CRF)

VCP   - print Visual Comfort Probability (VCP)

PLH   - print character contour plots of horizontal fc (no body shadow)

PLE   - print character contour plots of ESI, in each viewing direction

PLV   - print character contour plots of VCP, in each viewing direction

SUN   - print a sketch of the room showing those portions of the task plane
          which are exposed to direct sunlight at any time during the year.
          This keyword is used only when the CEL-1 daylight capabilities are
          exercised.

TDY   - print outputs which assist the user in executing the BLAST thermodynamics
          analysis program. For more details on this output, refer to appendix C.

LUM   - print room surface luminance

BLS   - request BLAST generator run for CEL-1.1

The keywords may appear on the line in any order; each pair must be separated
by exactly one space. The first

6.1 Control Cards

This section shows the card deck structure required to submit the CEL-1 programs to NOS via a remote batch terminal. Submission of the jobs via an interactive terminal is covered in Section VI.

In the discussion to follow the symbolism

<data deck>

means the cards containing the alphabetic and numeric data which are read in by the CEL-1 programs themselves. The data deck for the CEL-1 main program is described in detail in Sections II and III. The input data decks for the auxiliary file maintence programs CCMP and OBMP are described in Section IV. The remaining cards are called "NOS Control Cards" -- they are instructions to the NOS system itself. The "job stream" is the deck of cards obtained by combining the NOS control cards with the input data deck. Here is what the job streams should look like:

6.2 Job Stream for CEL-1 Main Program

```
<jobname>,P4,T500.
USER,<username>,<password>,<machine>.
GET,CELPROC/UN=M4800GS
CALL,CELPROC.
789 (end of record card)
```

<data deck>

```
6789 (end of file card)
```

6.3 Job Stream for Auxiliary Program OBMP

```
<jobname>,P4,T10.
USER,<username>,<password>,<machine>.
GET,OBMPROC/UN=M4800GS
CALL,OBMPROC.
```

789 (end of record card)

           <data deck>

  .

6789 (end of file card)

6.4 <u>Job Stream for Auxiliary Program CCMP</u>


```
<jobname>,P4,T10.
USER,<username>,<password>,<machine>.
GET,CCMPROC/UN=M4800GS
CALL,CCMPROC.
789 (end of record card)
```


           <data deck>

6789 (end of file card)

     In the above job streams, each card must be reproduced exactly as shown, except for the entries enclosed in the <> angle brackets, for which the substitutions are:

<jobname> is 1 to 7 alphanumeric characters which label the user's output.

<username> is the user's NOS account name.

<password> is the user's NOS account password.

<machine> identifies the NOS machine the user is running on (KWA or KBT)

In addition, the 789 (end of record card) means a card which has rows 7, 8, and 9 punched on column 1. The 6789 (end of file card) has rows 6, 7, 8, and 9 punched on column 1.

7.3 Creating the CEL-1 Data Deck using the Preprocessor

(user logs on)

GET,CELIFE/UN=M4800GS
Ready.
-Celife

-ENTER 5 LINES OF LABEL INFORMATION, MAX 80 CHARS PER LINE:

? EXAMPLE 1 - 40' X 30' X 10' ROOM
? REFLECTANCES: (WALLS=50%, FLOOR=20%, CEILING=80%
? XIX 2-LAMP FLUORESCENT LUMINAIRES (PHOTOMETRIC FILE 'HB57'),
?   3150 LUMENS PER LAMP
? NO FURNITURE OR DAYLIGHT.   CALCULATIONS: ESI, HORIZ FC, VCP

- ENTER INPUT UNITS, OUTPUT UNITS (1=ENGLISH 2=METRIC).   ENTER 2 VALUES

? 1 1

-ENTER FROOM DIMENSIONS, DISCRETIZATION ≠ 'S IN PAIRS:
 -WIDTH (E-W)
? 40 20
   -LENGTH (N-S)
? 30 15
   -HEIGHT
? 10 5

-ENTER SURFACE REFLECTANCES IN THIS ORDER:
   WEST WALL, NORTH WALL, EAST WALL, SOUTH WALL, FLOOR, CEILING

? .5 .5 .5 .5 .2 .8

 -HOW MANY ROOM SURFACE INSERTS
? 0

 -DO YOU WANT TO USE DAYLIGHT (Y/N)
? N

 -HOW MANY OBSTRUCTIONS ARE PRESENT IN THE ROOM
? 0

 -IS THIS A DESIGN SYNTHESIZER RUN (Y/N)
? N

 -DO YOU WANT TO CUMPUTE ESI RATINGS (Y/N)
? N

```
-ARE TASK LOCATIONS ON A RECTANGULAR GRID   (Y/N)
? Y
  -ENTER DETAILS FOR GRID OF TASK LOCATIONS:
  - ≠ COLUMNS  (MAX 21)
? 20
  - ≠ ROWS (MAX 21)
? 15
  -LEFTMOST X-COORDINATE
? 1
  -RIGHTMOST X-COORDIdNATE
? 39
  -LOWEST Y-COORDINATE
? 1
  -HIGHEST Y-COORDINATE
? 29
  -HEIGHT ABOVE FLOOR
? 2.5
  -OBSERVER EYE HEIGHT
? 4.

 -HOW MANY VIEWING DIRECTIONS
? 4
  -ENTER 4 VIEWING DIRECTION ANGLES
? 0 90 180 -90

  -WHICH METRICS DO YOU WANT TO PRINT OUT:
   -HORIZ FC (NO SHADOW)  (Y/N)
? Y
  -HORIZ FC (WITH SHADOW) (Y/N)
? N
  -ESI  (Y/N)
? Y
  -VCP  (Y/N)
? Y
  -BACKGROUND LUMINANCE  (Y/N)
? N
  -TARGET LUMINANCY  (Y/N)
? N
  -CRF  (Y/N)
? N
  -LEF  (Y/N)
? N
  -PLOT HORIZ FC  (NO SHADOW)  (Y/N)
? N
  -PLOT ESI  (Y/N)
? N
  -PLOT VCP  (Y/N)
? N
  -OUTPUT TO ASSIST IN INTERFACING BLAST  (Y/N)
? N

  -WHAT IS NAME OF FILE WITH BKGD LUMINANCE BRDF FACTORS
? P25B

  -WHAT IS NAME OF FILE WITH TASK LUMINANCE BRDF FACTORS
? P25T
```

```
-ARE TASK LOCATIONS ON A RECTANGULAR GRID   (Y/N)
? Y
  -ENTER DETAILS FOR GRID OF TASK LOCATIONS:
  - ≠  COLUMNS  (MAX 21)
? 20
  - ≠  ROWS (MAX 21)
? 15
  -LEFTMOST X-COORDINATE
? 1
  -RIGHTMOST X-COORDIdNATE
? 39
  -LOWEST Y-COORDINATE
? 1
  -HIGHEST Y-COORDINATE
? 29
  -HEIGHT ABOVE FLOOR
? 2.5
  -OBSERVER EYE HEIGHT
? 4.

 -HOW MANY VIEWING DIRECTIONS
? 4
  -ENTER 4 VIEWING DIRECTION ANGLES
? 0 90 180 -90

  -WHICH METRICS DO YOU WANT TO PRINT OUT:
  -HORIZ FC (NO SHADOW)  (Y/N)
? Y
  -HORIZ FC (WITH SHADOW) (Y/N)
? N
  -ESI  (Y/N)
? Y
  -VCP  (Y/N)
? Y
  -BACKGROUND LUMINANCE  (Y/N)
? N
  -TARGET LUMINANCY  (Y/N)
? N
  -CRF  (Y/N)
? N
  -LEF  (Y/N)
? N
  -PLOT HORIZ FC  (NO SHADOW)  (Y/N)
? N
  -PLOT ESI  (Y/N)
? N
  -PLOT VCP  (Y/N)
? N
  -OUTPUT TO ASSIST IN INTERFACING BLAST  (Y/N)
? N

  -WHAT IS NAME OF FILE WITH BKGD LUMINANCE BRDF FACTORS
? P25B

  -WHAT IS NAME OF FILE WITH TASK LUMINANCE BRDF FACTORS
? P25T
```

-HOW MANY DIFFERENT TYPES OF LUMINAIRES DO YOU INTEND TO USE
? 1

  -FOR LUMINAIRE TYPE ≠   1:
    -WHAT IS PHOTOMETRIC FILE NAME
? HB57
  -TOTAL INITIAL LAMP LUMENS
? 6300
. -LIGHT LOSS FACTOR
? .82
  -WIDTH OF LUMINOUS OPENING
? 1.833
  -LENGTH OF LUMINOUS OPENING
? 3.833
  -HEIGHT OF LUMINAIRE
? .5

-FOR EACH LUMINAIRE ENTER X,Y,Z COORDINATES AFTER "(X,Y,Z)"
 PROMPT? ENTER BEARING, TILT, CANT AFTER "ORIENT" PROMPT.

-LUM ≠   1:
  (X,Y,Z)
? 10 10 9.5
  ORIENT
? 0 0 0

-LUM ≠   2:
  (X,Y,Z)
? 20 10 9.5
  ORIENT
? 0 0 0

-LUM ≠   3:
  (X,Y,Z)
? 30 10 9.5
  ORIENT
? 0 0 0

-LUM ≠   4:
  (X,Y,Z)
? 10 20 9.5
  ORIENT
? 0 0 0

-LUM ≠   5:
  (X,Y,Z)
? 20 20 9.5
  ORIENT
? 0 0 0

-LUM ≠   6:
  (X,Y,Z)
? 30 20 9.5
  ORIENT
? 0 0 0

***   YOUR DATA DECK IS SAVED AS FILE ´CEL1DD´ - THE FILE DOES NOT HAVE LINE
      NUMBERS. YOU MAY LIST THE FILE AND/OR CHANGE IT USING THE NOS EDITOR.
      TO SUBMIT THE DECK FOR EXECUTION, KEY IN:

           GET,CEL1II/UN=M4800GS
           -CEL1II

7.6 Submitting the Job to NOS for Execution

   (user logs on, then creates the data deck file using an NOS editor. The
   data deck file for CEL1 (CEL1DD) may also be created using the preprocessor
   CELIFE)

GET,CEL1II/UN=M4800GS
READY,
-CEL1II

                    -- CEL-1 INTERACTIVE INTERFACE --

-ENTER ID OF PROGRAM YOU WANT TO RUN:
   1 = CEL-1
   2 = OBMP
   3 = CCMP
? 1

-ENTER PRIORITY FOR JOB (1,2,3,4, OR 6)
? 2

-LOCATION CODES ARE:
   F NAVFAC
   L LANTDIV
   S SOUTHDIV
   P PACDIV
   W WESTDIV
   N NORTHDIV
   H CEL, PORT HUENEME
   C CHESDIV
-ENTER YOUR LOCATION CODE
? H

-ENTER CODE FOR DISPOSITION OF OUTPUT:
   1 ROUTE TO YOUR REMOTE BATCH TERMINAL
   2 PRINT AT CENTRAL SITE, MAIL TO YOU
   3 SAVE FOR SUBSEQUENT RETRIEVAL AT INTERACTIVE TERMINAL

? 1

-ENTER YOUR FIRST NAME (MAX 10 CHARS)
? BILL

```
-IDENTIFY YOUR FAMILY NAME  (1 OR 2):
   1  = KWA
   2  = KBT
? 1

-DOES FILE 'CEL1DD' HAVE LINE NUMBERS  (Y/N)
? N

-DO YOU WANT TO SUBMIT THIS JOB  (Y/N)
?  Y
  19.56.56.A2MOKHE
READY.
```

Use these three letters to query
the job status with the command

ENQUIRE,JN=KHE

FUNITURE BLOCK:

FURNITURE _____

_____
OBSTRUCTIONS

_____
database   ID   X   Y   Z   orientation
(repeat above card for each different obstruction)

PROFILE BLOCK: (inlcuded only when computing energy profile and requesting
                  BLAST generator run)

PROFILE _____

lat. long.	long. at center of time zone	station ID	date of 1st sat.	date of 1st day	date of last day

_____
daylight savings time map

_____
occupancy factors

ANALYSIS BLOCK:

ANALYSIS _____

latitude longitude	longitude at center of time zone	station ID

_____
daylight savings time map

_____
times (maximum 15)

_____
month   day   time of day

(repeat above card for each time)

APPENDIX A - COMMON Block Variable Definitions

A-1 Common Block /COBAS/

This common block is the "basic" block in that it contains variables used by virtually all the programs.

ROOMD - the x, y, and z dimensions of the room
TORG   - the (x,y,z) coordinates of the point on a rectangular grid of target points which is nearest the origin
VIEW   - the viewing directions for a rectangular grid of target points
RHO   - the reflectance of the six room surfaces
WATTS - the watts consumption per luminaire at 100 percent gain
SQUAD - quadratic coefficients giving watts vs. gain
GMIN   - minimum gain to which a luminaire can be dimmed
LORG   - the point on a rectangular grid of luminaires which is nearest the origin (used only in design synthesizer)
NDIV   - # of discrete zones into which the room surfaces are divided - in order, x, y, and z directions
INDC   - 15 binary indicators governing which quantities are to be computer/ printed:

      1 - horizontal illumination   9 - plot horiziontal illum.
      2 - ESI   10 - plot ESI
      3 - raw illum. w/body shadow   11 - plot VCP
      4 - LEF   12 - Sun trace in room
      5 - CRF   13 - BLAST interface output
      6 - target luminance   14 - room surface luminances
      7 - background illuminance   15 - BLS (BLAST generator run)
      8 - VCP

DESC   - 5 lines of descriptive text to label output
DOESI - (0 = don't compute ESI, 1 = do compute ESI) Equivalenced to INDC(2)
OUNITS - output units (1=English, 2=metric)
IUNITS - input units (1=English, 2=metric)
IKNOWN - 1 = ESI Ratings to be computed at task locations, 2 = UNKNOWN task locations (rectangular grid), 3 = KNOWN task locations
NTC   - # columns of target points (UNKNOWN task locations)
NTR   - # rows of target points (UNKNOWN task locations)
DCT   - grid column space (UNKNOWN task locations)
DRT   - grid row spacing (UNKNOWN task locations)
NV   - # viewing directions
NFTYPE - # fenestration sub-blocks actually describing fenestrations
NWIND - # fenestration source elements (windows, skylights, etc.)
NSURF - # exterior building surfaces + # ground surfaces
NTASKL - # task locations
NTP   - # target points
NFOTO - # different photometric files used
GREF   - reflectance of ground
NINS   - # of room surface inserts
IOP   - 1 ESI Rating at IES viewing directions, 2 ESI Rating at Navy viewing directions
NEWP   - = NDIV(1) = # discrete room zones in x-direction

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

This is a guide to using the CEL-1.1 version of the CEL-1 Lighting Computer Program. CEL-1.1 has the capability of producing hour-by-hour lighting power multipliers for a one-year simulation period. This guide focuses on:

    a)   the new program routines
    b)   the interactive capabilities of CEL-1.1
    c)   the routines for compiling different types of routines
    d)   computer terminology and accessing the necessary routines for running
        CEL-1.1
    e)   updates and revisions to the existing CEL-1 manuals.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*
BLAST generator; cloud ratio; direct and diffuse illuminance; direct and diffuse irradiance; lighting power multipliers.

| 13. AVAILABILITY

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